THE CONSUMPTION OF FOOD NUTRIENTS IN RELATION TO HOUSEHOLD CHARACTERISTICS IN THE STATE OF NORTH CAROLINA

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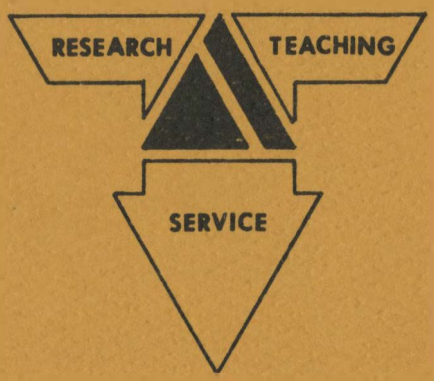

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THE CONSUMPTION OF FOOD NUTRIENTS IN RELATION TO HOUSEHOLD CHARACTERISTICS IN THE STATE OF NORTH CAROLINA[1]

INTRODUCTION

In recent years much attention has focused on the deterioration of the nutritional level of American diets. Despite the availability of sizable and diverse food supply, some citizens consume less than recommended dietary allowances of food nutrients.

Little research efforts have been devoted to the analysis of the impact of income and other socio-demographic characteristics of the household on the consumption of food nutrients on a state level. Most of the studies in the area of food consumption have concentrated on the relationship between selected household characteristics and quantity of food consumption or expenditure measures. Obviously, the major drawback of each of these approaches is that there is no guarantee that a large quantity of food consumption or a high level of food expenditure will assure adequate level of nutrient consumption.

A statewide survey of the nutritional intakes of the North Carolinian was conducted in 1970 by the North Carolina Department of Health. Over 900 households were surveyed by the 24-hour recall method.

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[1]The study was supported by North Carolina Agricultural Experiment Station (Project 5349, "Nutritional Adequacy of Diets of North Carolina Households").

The reference nutritional standards used by the North Carolina Department of Health in assessing the adequacy of diets of the state's households differed greatly from those Recommended Dietary Allowances (RDA) established by the National Academy of Science National Research Council. Even though any nutritional standards represent a judgment based upon practical experience with groups of individuals consuming diets of differing nutrient content, most studies designed to evaluate nutrient requirements of groups of individuals in this country used the RDA. Therefore, in order to relate and compare the nutritional status in the State of North Carolina to other studies, it is necessary to use the RDA in assessing the state's nutritional status.

Objectives

The objectives of this study were (1) to assess the nutritional intakes in the State of North Carolina by using the Recommended Dietary Allowances (RDA) established by the National Academy of Science-National Research Council in 1974, and (2) to examine the effects of selected characteristics of the household on food nutrient intakes.

Review of Related Literature

The data of the 1965-66 USDA Household Food Consumption Survey (USDA 1968a, 1968b, 1969a, 1969b, 1970a, 1970b) revealed that about one fifth of the nation's households had a "poor" diet that furnished less than two thirds of RDA for one or more of seven nutrients and calories. The Southern Region had a slightly high proportion of "poor" diets than the other three regions did. The percentages were 24 percent for the South, 22 percent for the North Central, 18 percent for the Northeast, and 17 percent for the West.

High proportions of "poor" diets in the South were the result of low intakes of vitamin A, calcium, and ascorbic acid. Twenty-eight percent of the diets in the South contained less than two thirds of RDA for vitamin A. Approximately 30 percent of the Southern households had diets that furnished less than two thirds of RDA for calcium. Diets of households that failed to meet the ascorbic acid recommendations comprised about 32 percent of all diets.

Studies which addressed the problem of nutritional adequacy have been primarily involved with particular groups of people. A study by Miller, Penny, and Elrod (1970) of 160 households in the city of Atlanta, Georgia, over a five-year period, concluded that black households with under $4,000 per year income had the highest incidence of inadequate diet intake.

In a 1967 study conducted by the USDA in Sunflower County, Mississippi, income, urbanization, and race were found to have a rather significant impact on the adequacy of diets of families (Kelsay, 1969).

The Guilford County Nutrition Committee in cooperation with the city schools of Greensboro, North Carolina, (Edwards, Hogan, and Spahr, 1964) conducted a teen-age food survey. Over 6,000 public students were surveyed. About 25% of the students did not have the recommended two or more servings from the meat group. Only about 20% of the students reported eating any dark green or yellow vegetables. Approximately half the students consumed no food rich in vitamin C.

Ford (1967) examined the dietary practices of 109 low-income black families in Greenwood, Mississippi. It was found that about half of the diets were rated as poor and inadequate.

Young, Waldner, and Berresford (1956) studied the relation of the homemaker's nutritional knowledge to her age, formal education, previous study of what to feed her family, and the family income in urban Rochester and Syracuse in New York State. In their results, formal education was the most important factor in explaining the homemaker's knowledge of nutrition; nutritional knowledge seemed to be greatest among younger homemakers. There was an inconsistent pattern in the relationship between nutritional knowledge and family income.

Jalso, Burns, and Rivers (1965) examined the relationship of age, education, socioeconomic level, and personality rigidity to nutritional opinions and practices in New York State. A positive relationship between education and valid nutritional opinions and practices was attributed to the effect of age rather than education directly. Subjects who composed the "faddist" group were found to have more rigid personalities.

Madden and Yoder (1972) estimated the effects of the Food Stamp and Commodity Distribution Programs on the improvement of the recipient families' dietary intake in rural Pennsylvania. Also, the study was designed to investigate the effects of the change in family participation status in food aid programs on the adequacy of their diets. Other factors which were considered included cost-effectiveness, nutritional efficiency, and effects on food purchases. The main conclusions of the study were the following:

1. There was no improvement in diets resulting from participating in the Commodity Distribution Program.
2. The Food Stamp Program provided some improvement in diets for families whose payday was more than two weeks from the interview date.

3. The impact of the Food Stamp Program on the improvement of diets was not significant when the payday of the participant was less than two weeks of the interview date.
4. The diet of low-income families was found to be most deficient in vitamin A and calcium and least deficient in protein and phosphorous.
5. The diets of families receiving income at least once every two weeks were more adequate than were those of families receiving income less frequently.
6. The nutritional value per dollar of food expenditure was higher for families with fewer financial resources available.
7. There was a negative relationship between nutritional adequacy and nutritional efficiency (nutrients/dollar spent).
8. The Food Stamp Program did not increase the value of food purchased.

Kellerman (1972) analyzed the influences of selected household characteristics on the dietary adequacy and food shopping efficiency of low-income rural households in Missouri. Used as an index of food shopping efficiency, the Daily Recommended Food Servings Efficiency (DRSE) was computed from two other variables: the Daily Recommended Food Servings Adequacy (DRSA) and the household's Food Expenditures Per Person Per Day (FE). The DRSA was the average of the percentages that indicate the extent to which the household had met its daily recommended servings of the following four food groups: bread-cereal, meat, milk, and vegetable-fruit. The DRSA was divided by FE to arrive at DRSE.

Multiple regression analysis was used by Kellerman to test the relationships between variables. The main conclusions of the study

included the following: print media and broadcast media exposure were significantly related to DRSA; age had a negative association with DRSA; household size was positively associated with DRSE. The improvement in DRSE with increased household size was attributed to economies of scale in food consumption. The reduction in efficiency of DRSE associated with income increase was attributed to the greater demand for foods with low nutritional values as income increases.

Abdel-Ghany and Bivens (1976), using the Spring portion of the 1965-66 USDA Household Food Consumption Survey, examined the income-consumption relationships for energy and nine individual nutrients. In addition, the study investigated the effects of selected socio-demographic factors upon the nutritive intakes of food consumption.

Using the same source of data, Adrian and Daniel (1976) examined the nutrients consumption responsiveness to income. The impact of selected socioeconomic factors on the consumption of selected food nutrients was also analyzed.

Hoover and Whittaker (1972) analyzed the data used in the present study. Their analysis was founded on the use of the North Carolina Nutrition Survey Standards in measuring nutritional adequacy of households. The regression analysis of the data indicated income was a significant variable for five of the nine nutrients, whereas race was insignificant. Education of the homemaker was generally significant and positively correlated with nutrition. Also, eastern North Carolinians had a lower nutrient intake level than did those in the western part of the state, after the effects of other variables were accounted for.

DATA SOURCE AND SAMPLE CHARACTERISTICS

Data Source

The source of data for this study was the North Carolina Nutrition Survey of 1970 (North Carolina State Board of Health, 1971). The survey was designed to provide a representative sample of the household population in the State of North Carolina. One hundred clusters constituted the survey population. They were allocated to predetermined strata in numbers directly proportional to the number of occupied housing units reported in the 1960 census. Simple random sampling of clusters within strata was performed in such a way that resulted in a self-weighting sample. The strata were formed, firstly by dividing North Carolina into three regions: the eastern, Piedmont, and western regions. Secondly, the population in each of the three regions was categorized in terms of six sizes according to place of residence.

The field survey was conducted by the staff of the nutrition section of the State Board of Health with the help of the nutritionist of the Mecklenburg County Health Department. The nutritionist-interviewer administered five questionnaires designed to collect the household data. The 24-hour recall method was used to obtain data on food intake for the household.[2]

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[2]Compared with the seven-day food inventory, the 24-hour recall method would tend to introduce less bias, since the memory or recall requirement is much less than in the seven-day recall method. A comprehensive discussion of alternative methods of determining dietary intake can be found in Guthrie (1971, pp. 306-308), Morgan (1959, pp. 12-15), and Madden and Yoder (1972, pp. 25-27). These studies indicate that, in general, the 24-hour recall is the best method for determining the adequacy of dietary intakes for large groups of respondents.

Nine hundred and thirty-six households were surveyed. Households with missing responses for any of the variables used in this study were eliminated. Thus, 767 households were included.

Characteristics of Households in the Sample

A little over 36 percent of all households were urban, whereas nearly 64 percent represented rural areas. The eastern region contained almost one fourth of the households in the sample. The Piedmont and the western regions represented 43.5 percent and 32.1 percent of all households, respectively (Table 1).

Nearly 84 percent of all households were white. The remaining 16 percent were non-white (Table 1). Slightly over six percent of the households reported an annual income of less than $1,500. Close to nine percent of the households fell in the income range of $1,500-2,999. Almost one fourth of all households had incomes ranging from $3,000 to $5,999. About 27 percent reported incomes between $6,000 and $8,999. About 34 percent had incomes as high as $9,000 or above (Table 1).

Almost 44 percent of all households had a female homemaker participating in the labor force. The remaining 55 percent were not employed in the market. About 12 percent of the sample had homemakers with six years of schooling or less. Households with homemakers having seven to ten and 11 to 12 years of schooling were 31.2 and 36.2 percent of all households, respectively (Table 1). Households with homemakers having from one to three years of college education represented about 12 percent of the sample. Around eight percent had college degrees or had done graduate work.

TABLE 1

DISTRIBUTION OF NORTH CAROLINA HOUSEHOLDS, BY SELECTED CHARACTERISTICS, NORTH CAROLINA NUTRITION SURVEY, 1970

Household Characteristics	Percent
Place of residence	
Urban	36.4
Rural	63.6
Total	100.0
Region of residency	
Eastern	24.4
Piedmont	43.5
Western	32.1
Total	100.0
Race	
White	84.2
Non-white	15.8
Total	100.0
Annual household income	
Under $1,500	6.1
$1,500 - 2,999	8.6
$3,000 - 5,999	24.3
$6,000 - 8,999	26.5
$9,000 and over	34.4
Total	100.0
Labor force participation	
Working	43.9
Non-working	56.1
Total	100.0

TABLE 1 (Continued)

DISTRIBUTION OF NORTH CAROLINA HOUSEHOLDS, BY SELECTED CHARACTERISTICS, NORTH CAROLINA NUTRITION SURVEY, 1970

Household Characteristics	Percent
Education of the homemaker	
Sixth grade or less	12.4
Seventh - Tenth grade	31.2
Eleventh - Twelfth grade	36.2
One - Three years of college	11.7
Four years of college or graduate work	8.4
Total	100.0
Nutrition knowledge of the homemaker	
Very limited	9.2
Limited	52.8
Good	38.0
Total	100.0
Number of eating units	
1 - 2	25.4
3 - 5	50.1
6 -10	12.6
11 and more	11.8
Total	100.0
Adequacy of food preparation facilities	
Standard	91.7
Substandard	8.3
Total	100.0
Status of aged persons	
No aged persons	84.0
Some members over 65	11.7
All members over 65	4.3
Total	100.0

Slightly less than one out of ten (29.2 percent) of the female homemakers had a very limited knowledge about nutrition, a fact revealed by the results of a test administered verbally to them (North Carolina State Board of Health, page 26).[3] Exactly 38 percent of the homemakers had a good knowledge of nutrition; the remaining 52.8 percent had rather limited knowledge of nutrition, a finding evidenced by their scores on the test administered.

Slightly more than eight percent of all households were designated as having substandard food preparation facilities: i.e., households without piped-in water, stove, oven, or means of refrigeration (Table 1).

Exactly 84 percent of households included no aged persons (65 years or more). Slightly over four percent of all households in the sample were composed of members who were 65 years or older. About 12 percent of the households had some members who were that age (Table 1).

EVALUATION OF DAILY NUTRIENT INTAKE

The North Carolina Nutrition Survey Standards and the Recommended Dietary Allowances

The reference nutrient standards established by the North Carolina State Board of Health for the purpose of its nutrition survey are shown in Table 2. A comparison of the North Carolina Nutrition Survey Standards (NCNS) with the Recommended Dietary Allowances (RDA) established by the Food and Nutrition Board of the National Research Council (Table 3) reveals that the NCNS was far below the RDA with respect to the intakes of calcium, vitamin A, and ascorbic acid--which represent the three most lacking nutrients in the American diets (Abdel-Ghany, 1974, p. 48).

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[3]On the basis of a range of scores obtained from a nutrition knowledge test administered verbally to homemakers, test scores were grouped as follows: 0-3 (very limited), 4-7 (limited), and 8-10 (good).

Also, the NCNS for thiamin was lower than that of the RDA was. Calorie and niacin standards were higher than those of the RDA for the reference man (20 to 30 years of age, doing moderate work). However, taking a closer look at Table 2 and Table 3, we find this is not the case for most of the age-sex categories. The NCNS for protein was higher than that of the RDA for almost all age-sex categories; however, this nutrient is one of the most available nutrients in the American diet (Abdel-Ghany, 1974, p. 48).

When the nutrient adequacy in the diets is evaluated, the amount of individual nutrient in each household diet is compared with that in the recommended standards. In most studies of dietary adequacy, intakes of less than two thirds of the RDA have been considered as indicative of suboptimal diets. In NCNS half of its standards were used as criteria for defining diet adequacy.

Percentage distributions of the sample households according to suboptimal dietary intakes evaluated by the RDA and the NCNS are presented in Table 4. The proportions of households with suboptimal dietary intakes increased noticeably when the intakes were evaluated by the RDA. As it was discussed above, two factors have contributed to that increase: (1) the lower NCNS standards for most of the nutrients and (2) the use of one half of the NCNS standards as the cut-off point in defining suboptimal intakes, whereas intakes below two thirds of the RDA were used in defining suboptimal diets.

When the household diets were evaluated by the RDA, vitamin A, calcium, and thiamin were found to be the most limited nutrients in the North Carolina diets. More households, however, had a lower proportion of recommended intake for vitamin A than for any other nutrient. The percentage of households with suboptimal vitamin A intakes was slightly more than 56 percent of all households.

TABLE 2

NORTH CAROLINA NUTRITION SURVEY STANDARDS*

Age	Sex	Wt (kg)	Calories (per kg)	Protein (gm per kg)	Calcium (mg)	Iron (mg)	Vit A (IU)	Other (All Ages)
Months								
0 - 1	M&F	4.1	120	2.2	688	10	1070	Thiamin
2 - 5	M&F	6.8	110	2.2	688	10	1070	0.4 mg per 1000
6 -11	M&F	9.0	100	2.2	688	10	1070	calories
Years								
1	M&F	11.4	90	1.9	561	15	1430	Riboflavin
2 - 3	M&F	14.6	86	1.7	561	15	1430	0.55 mg per 1000
4 - 5	M&F	18.5	82	1.5	561	10	1430	calories
6 - 7	M&F	23.2	82	1.3	561	10	1785	
8 - 9	M&F	29.0	82	1.3	561	10	1785	
10 -12	M	35.8	68	1.2	813	10	1785	Niacin
	F	37.5	64	1.2	813	18	2500	6.6 mg
13 -16	M	53.2	60	1.2	813	18	2500	per thousand
	F	52.5	48	1.2	813	18	2500	calories
17 -19	M	64.7	44	1.1	688	18	2500	Ascorbic
	F	57.3	35	1.1	688	18	2500	Acid
20 -29	M	74.9	40	1.0	500	10	2500	(Vitamin C)
	F	62.4	35	1.0	500	18	2500	30 mg daily
30 -39	M	78.0	38	1.0	500	10	2500	
	F	65.9	33	1.0	500	18	2500	
40 -49	M	78.5	37	1.0	500	10	2500	
	F	69.3	31	1.0	500	18	2500	
50 -59	M	78.5	36	1.0	500	10	2500	
	F	71.6	30	1.0	500	10	2500	
60 -69	M	76.6	34	1.0	500	10	2500	
	F	72.0	29	1.0	500	10	2500	
70 &	M	75.6	34	1.0	500	10	2500	
Over	F	69.8	29	1.0	500	10	2500	
Add To Basic Standards:								
Pregnant			200	20.0	400		1000	
Lactating			1000	25.0	500		1000	

*North Carolina State Board of Health, North Carolina Nutrition Survey, Part One (Raleigh, North Carolina: North Carolina State Board of Health, 1971), p. 30.

TABLE 3

FOOD AND NUTRITION BOARD, NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL
RECOMMENDED DAILY DIETARY ALLOWANCES (Revised 1974)

*Designed for the maintenance of good nutrition of practically all healthy people in the U. S. A.**

	Age (years)	Energy (kcal)	Protein (g)	Vitamin A (IU)	Ascorbic Acid (Vitamin C)(mg)	Niacin (mg)	Riboflavin (mg)	Thiamin (mg)	Calcium (mg)	Iron (mg)
Infants	0.0-0.5	kg x 117	kg x 2.2	1,400	35	5	0.4	0.3	360	10
	0.5-1.0	kg x 108	kg x 2.0	2,000	35	8	0.6	0.5	540	15
Children	1-3	1,300	23	2,000	40	9	0.8	0.7	800	15
	4-6	1,800	30	2,500	40	12	1.1	0.9	800	10
	7-10	2,400	36	3,300	40	16	1.2	1.2	800	10
Males	11-14	2,800	44	5,000	45	18	1.5	1.4	1,200	18
	15-18	3,000	54	5,000	45	20	1.8	1.5	1,200	18
	19-22	3,000	54	5,000	45	20	1.8	1.5	800	10
	23-50	2,700	56	5,000	45	18	1.6	1.4	800	10
	51+	2,400	56	5,000	45	16	1.5	1.2	800	10
Females	11-14	2,400	44	4,000	45	16	1.3	1.2	1,200	18
	15-18	2,100	48	4,000	45	14	1.4	1.1	1,200	18
	19-22	2,100	46	4,000	45	14	1.4	1.1	800	18
	23-50	2,000	46	4,000	45	13	1.2	1.0	800	18
	51+	1,800	46	4,000	45	12	1.1	1.0	800	10
Pregnant		+ 300	+ 30	5,000	60	+ 2	+ 0.3	+ 0.3	1,200	18+
Lactating		+ 500	+ 20	6,000	80	+ 4	+ 0.5	+ 0.3	1,200	18

*Derived from: National Academy of Sciences, Recommended Dietary Allowances--A Report of the Food and Nutrition Board National Research Council (Washington, D. C.: National Academy of Sciences, 1974)

Table 4

PERCENTAGE OF HOUSEHOLDS WITH SUBOPTIMAL DIETARY INTAKES AS EVALUATED BY THE 1974 RDA AND NCNS

NORTH CAROLINA NUTRITION SURVEY, 1970

Nutrient	U. S. RDA Standard	NCNS Standard
Calorie	36.1	5.8
Protein	7.5	1.8
Thiamin	45.0	2.2
Riboflavin	30.2	2.5
Niacin	26.0	15.8
Iron	31.5	15.7
Vitamin A	56.2	11.1
Calcium	46.7	13.2
Ascorbic Acid	28.6	10.7

of 0.7, the MAR would be 0.7. In this case, the suboptimal ratio of protein was compensated for by the higher ratio of iron.

The Nutrient Sum (NS), another measure of the quality of food intake (Abdel-Ghany, 1974), was used in the present study. It indicates the total number of nutrients for which the household's intake meets or exceeds the critical level of 67 percent of the RDA's. Even though the index does not permit compensation of one nutrient for the other, it does not help to differentiate between households which are barely below the critical level and those which are far below it; both would get a value of zero for not satisfying the critical level. Also, the index would not indicate or give weight for not satisfying the critical level of some nutrients which seem more important and vital than others are. The MAR index shares the same weakness.

Table 5 exhibits the percentage distribution of households according to the number of nutrients for which they failed to meet two thirds of their RDA. Only about three percent of all households had suboptimal intakes of all nine nutrients. About five percent of the sample showed less than optimal intake of eight nutrients, 9.2% of seven nutrients, 5.8% of six nutrients, 7.5% of five nutrients, 9.0% of four nutrients, and 11.1% of three nutrients. Households which had suboptimal intake of one or two nutrients represented 12.7% and 13.6%, respectively. About one out of four households (23.7%) had optimal intakes of the nine nutrients studied.

METHODOLOGY

Independent Variables

Place of residence, region of residency, race, female labor force participation status, and adequacy of food preparation facilities were coded as dummy variables. Rural, Piedmont-region, whites, participating in the labor force, and standard food preparation facilities were scored zero. Household income, formal education of the homemaker, nutrition education of the homemaker,[4] number of eating units, preschool ratio (percent of the family that are preschoolers), and elderly ratio (percent of the family that are 65 years or older) were introduced as continuous variables in the regression model.

Dependent Variables

The nutrient adequacy ratio[5] of energy and other eight nutrients as well as a composite index of nutritional adequacy were the dependent variables used in the present study. These variables are as follows:

1. Household energy adequacy ratio
2. Household protein adequacy ratio
3. Household calcium adequacy ratio
4. Household iron adequacy ratio
5. Household vitamin A adequacy ratio
6. Household thiamin adequacy ratio
7. Household riboflavin adequacy ratio

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[4]Interested readers can find the detailed information on the nutrition knowledge test in North Carolina State Board of Health, 1971.

[5]A nutrient adequacy ratio is the proportion of the Recommended Dietary Allowances (RDA) which is met by the household's actual intake of that nutrient.

8. Household niacin adequacy ratio
9. Household ascorbic acid adequacy ratio
10. Household nutritional adequacy index (nutrient sum).

The Model

A multiple regression model was used to test the significance of each of the independent variables while the simultaneous effects of the rest of the variables are controlled.

The model may be represented as follows:

$$Y = a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+b_8x_{81}....+b_9x_{82}+b_{10}x_9+ b_{11}x_{10}+b_{12}x_{11}$$

where:

Y is the dependent variable,

a is a constant term,

x_1 is the household income,

x_2 is the education of the homemaker,

x_3 is the nutrition education of the homemaker,

x_4 is the number of eating units,

x_5 is the preschool ratio,

x_6 is the elderly ratio,

x_7 represents the place of residence in the form of a dummy variable,

$x_{81}.....x_{82}$ is the region variable in the form of dummy variables,

x_9 represents the race of the homemaker in the form of a dummy variable,

x_{10} is the labor force participation variable in the form of a dummy variable,

x_{11} is the adequacy of food preparation facilities variable in the form of a dummy variable, and

b_1 ....b_{12} are the regression coefficients.

It should be noted that, in testing for the significance of a dummy variable coefficient, we are testing to see if that coefficient is significantly different from that of the omitted category. For continuous variables, however, the coefficients indicate the direction and magnitude of the effect on the dependent variable of a one-unit increase in the continuous independent variable.

RESULTS AND DISCUSSION

Household Income

As it is shown in Tables 6 through 8, household income had no significant effect on any of the studied adequacy ratios or the NS. Young, Waldner, and Berresford (1956, p. 221) "found no consistent pattern in the relationship between family income and nutritional knowledge." This finding suggests that an increase in income may not necessarily increase nutritional knowledge. Madden and Yoder (1972, p. 57) found income to be a significant variable in relation to the nutritional adequacy of protein, calcium, and vitamin A. Abdel-Ghany (1974, p. 112) found a significant relationship between income and the nutritional adequacy of protein, niacin, vitamin A, ascorbic acid, iron, and NS. Kellerman (1972, p. 123), however, found no significant relationship between income and the daily recommended food serving adequacy.

Education of the Homemaker

Education of the homemaker had only a significant effect on the nutritional adequacy of ascorbic acid (Tables 6 to 8). Abdel-Ghany and Bivens (1975, p. 4) concluded that the relationship between the education of the homemaker and nutritional adequacy ratios is uncertain. Although the education of the homemaker was positively correlated with

adequacy ratios for vitamin A and ascorbic acid, it was negatively correlated with calories, iron, thiamin, and niacin. Madden and Yoder (1972, p. 54), as well as Kellerman (1972, p. 121), found that education was not significantly related to adequacy of nutritive intakes and the daily recommended food servings adequacy in their respective studies.

Nutritional Knowledge of the Homemaker

Nutritional knowledge of the homemaker had a positive significant effect on the nutritional adequacy ratio for each of the studied nutrients as well as for the NS, with the exception of thiamin (Table 6 through 8). This finding seems to be of importance to decision and policy makers, since improved nutritional knowledge through educational programs and/or extension services might have very significant returns compared with returns of other nutrition programs.

Number of Eating Units

The number of eating units had a positive effect on the adequacy ratios of all individual nutrients and the NS (Tables 6 to 8). The positive correlation between the number of eating units and the adequacy ratios of nutrients while the effect of the other socio-demographic variables are controlled indicates that an increase in household size resulted in an increase in the quantity of all nutrients consumed by the household. Such a finding can be attributed to the economies of consumption resulting from household size.

TABLE 6

ESTIMATED PARTIAL REGRESSION COEFFICIENTS FOR SELECTED HOUSEHOLD CHARACTERISTICS AND THE ADEQUACY RATIO OF ENERGY, PROTEIN, AND THIAMIN - NORTH CAROLINA NUTRITION SURVEY, 1970

Item	Adequacy Ratio of		
	Energy	Protein	Thiamin
Household Income	.00	.00	.00
Education of the Homemaker (Years)	-.53	.42	-.56
Nutritional Knowledge of the Homemaker	1.52**	2.47**	.95
Number of Eating Units	1.27***	.65***	1.30***
Preschool Ratio	18.29*	28.59*	9.05
Elderly Ratio	10.78*	-2.61	-1.13
Place of Residence:			
Rural	omitted	omitted	omitted
Urban	-5.36*	-8.43*	-9.77**
Region of Residence:			
Eastern	-8.47**	-4.57	-1.19
Piedmont	omitted	omitted	omitted
Western	-4.28	-4.04	-1.40
Race:			
Non-White	-5.46	4.48	3.88
White	omitted	omitted	omitted
Labor Force Participation:			
Working	omitted	omitted	omitted
Non-Working	3.02	3.54	3.09
Adequacy of Food Preparation Facilities:			
Standard	omitted	omitted	omitted
Substandard	-4.68	-12.21	-4.38
R^2	.61***	.20***	.46***

***P <.001; **P < .01; *P < .05

TABLE 8

ESTIMATED PARTIAL REGRESSION COEFFICIENTS FOR SELECTED HOUSEHOLD CHARACTERISTICS AND THE ADEQUACY RATIO OF VITAMIN A, ASCORBIC ACID, AND THE NUTRIENT SUM (NS) - NORTH CAROLINA NUTRITION SURVEY, 1970

Item	Adequacy Ratio of		
	Vitamin A	Ascorbic Acid	Nutrient Sum (NS)
Household Income	.00	.00	.00
Education of the Homemaker (Years)	.84	3.35***	-.01
Nutritional Knowledge of the Homemaker	1.54*	2.37*	.14***
Number of Eating Units	1.40***	.86***	.04***
Preschool Ratio	11.62	-10.43	.88
Elderly Ratio	3.72	34.55***	.87*
Place of Residence:			
Rural	omitted	omitted	omitted
Urban	-1.78	5.46	-.41
Region of Residence:			
Eastern	-10.23*	-16.72**	-.55*
Piedmont	omitted	omitted	omitted
Western	-.18	-4.21	-.27
Race:			
Non-White	4.14	-10.35	-.29
White	omitted	omitted	omitted
Labor Force Participation:			
Working	omitted	omitted	omitted
Non-Working	4.61	5.53	.34
Adequacy of Food Preparation Facilities:			
Standard	omitted	omitted	omitted
Substandard	-8.80	-13.75	-.45
R^2	.54***	.25***	.21***

***P < .001; **P < .01; *P < .05

Preschool Ratio

Tables 6 to 8 indicate that, although preschool ratio in the household had a positive effect on the adequacy ratios of energy, protein, and riboflavin, it had a negative effect on the adequacy ratio of iron.

Elderly Ratio

As it is shown in Tables 6 to 8, the elderly ratio had a positive effect on the adequacy ratios of energy, iron, calcium, ascorbic acid, and NS.

Place of Residence

Nutrient adequacy ratios of urban households were negative and statistically significantly different from the rural households for energy, protein, thiamin, and riboflavin (Tables 6 to 8). This finding implies that the adequacy of nutritional intakes regarding these nutrients would deteriorate as the State of North Carolina becomes more urban.

Region of Residence

The partial regression coefficients of the eastern region were negative and statistically significantly different from the Piedmont region for energy, iron, calcium, vitamin A, and ascorbic acid. The coefficients of the western region were negative and significantly different from the Piedmont region for niacin; they were positive and significantly different for calcium (Tables 6 to 8).

Race

Tables 6 to 8 indicate that nutrient adequacy ratios of white and nonwhite households were not significantly different from each other.

Labor Force Participation

There were no significant differences in nutrient adequacy ratios between households with working homemakers and those with nonworking homemakers (Tables 6 to 8).

Adequacy of Food Preparation Facilities

The partial regression coefficients of households with substandard food facilities were not significantly different from those of households with standard food facilities (Tables 6 to 8).

SUMMARY AND CONCLUDING COMMENTS

The study discussed the nature and extent of undernutritional intakes in the State of North Carolina as measured by the gap, or deficit between the actual intakes and the Recommended Dietary Allowances for the households.

An analysis of the effects of selected characterisitics of the household on food nutrient intakes was also undertaken. The results indicate that the percentage of North Carolina households with suboptimal dietary intakes ranged from 7.5 percent regarding the intake of protein to 56.2 percent for vitamin A. The results also show that only 23.7 percent of the households had optimal diets with respect to the nine studied nutrients.

The multiple regression analysis identified the nutritional knowledge of the homemaker to be an effective factor in improving food intake. Also, the results signify the positive relationship between household size and nutritional adequacy of diets, while other factors are controlled. The difference in our results from those of Hoover and Whittaker may be the result of the use of different models.

The following recommendations are presented as suggestions to improve the nutritional intakes in the State of North Carolina:

1. There is a need to evaluate the present nutrition education programs and to identify effective educational techniques and strategies to modify attitudes and behavior regarding good nutrition in both the short and the long run.
2. There is a need to develop an effective media integrated campaign to combat food and nutrition misinformation in order to enable households to make nutritionally sound food choices.
3. There is a need to evaluate the effectiveness and efficiency of all existing food programs.
4. There is a need to develop and evaluate in-service education of teachers aimed at making nutrition education a valued component in teacher education.

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